SUPPLEMENT.

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RAILWAY AND COMMERCIAL GAZETTE:
FORMING A COMPLETE RECORD OF THE PROCEEDINGS OF ALL PUBLIC COMPANIES.

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RAILWAYS—WHO IS THEIR FATHER?

[Concluded from the Supplement to the Mining Journal of September 27.]

We now approach the debateable ground whereon must be decided between William James and George Stephenson not superiority but priority of design. Documentary evidence, most important to the settlement of this question, exists to identify James with railroad plans and their practical details as early as the year 1799. In 1800, 1802, 1803, and 1804, he was actively engaged in projects, surveys, traffic estimates, and all the intricacies of calculation contingent on the formation of rail and other roads, canals, &c. Lines in Lancashire to Leigh, Ashton, the Duke of Bridgewater's Canal, and three separate rail projects to the Leeds and Liverpool and Duke's Canal, also railways from Liverpool to Manchester, Bolton, and other places, occupy his time and energies at this period. The years 1806, 1807, and 1808 found him devoted not only to mining enterprises of considerable magnitude, but to the drainage of Lambeth Marsh, enclosure of Dulwich Common, a road from Dulwich to London, *improvements* in rails, of his latest he was in 1823 the patentee; and it is more pertinent to our object to notice emphatically that an extract from one of his communications with the Grand Surrey Canal Company completely substantiates the fact that his "experience as an engineer in railroads especially" had long before fixed his attention on the facilities and advantages of passenger traffic; for the document goes on to say—"And that the said railroads, and all person or persons and their servants, carriages, and cattle passing thereon," &c. A tunnel under the Thames from College-lane, in Lambeth, to Scotland-yard Wharf, was at this time one of his prominent projects. A railway in Cornwall, divers lines in sundry other districts; and, as if to cap his prescience of the universal desideratum, he proposed to a too listless community the formation of a "General Railroad Company," with a capital of one million, to "take lands for ever to form railroads" through the kingdom, &c. A man of so astute a mind, who, in those days of steam-transit scepticism, could have designed an association of such extensive enterprise, was not likely to overlook *engine-passenger traffic*. Its conception was natural to his habits of thought and the avocations they created; and a writer some years since very justly remarked that Mr. James's letter to the Prince Regent, in 1815, showed that he had entertained the idea of rapid locomotion by *steam* and other agents several years antecedent to it; but the time was not ripe for the project. There is reason further to believe that as early even as 1800 the glowing intelligence of James reflected on this scientific possibility, and his anticipations were being defined that the achievement would be in time forced upon the nation as a great commercial necessity.

His project—the Manchester and Liverpool line, intended for engine-passenger conveyance—bears in substantiating evidence upon this assumption. No one who reads the memoir of his life—a memoir of established fame—can come to any other conclusion than that William James, than whom no man was more observant, and whose predilections for mineral enterprise—the large personal interest he had involved therein, together with his natural ambition to distinguish himself by increasing the proprietorial resources of those whose properties he managed as land agent, constituted an impetus—one ever strengthening with endurance—to invent and improve every means of produce—transit failed not, almost *ab initio* to connect with the great importance of facile transmission, of agricultural and commercial material, that of rapid travelling for those engaged in the various department of our national traffic. Nor is it to be supposed that when he visited Killingworth, and had his first interview with the mechanical Stephenson, his fertile and cultivated mind had not gained in a very advanced degree a project for the realisation of this his favourite theory.

What were, then, the relative positions of William James and George Stephenson in 1821, when they first met? The former was one whose status as a gentleman of birth, education, extensive knowledge of the legal profession, eminence as an engineer, land surveyor, and land agent, and, though last not least, a large landed and coal mine proprietor, had been long an acknowledged fact,—the latter, Stephenson, was simply an engine-man at Killingworth. This is not recorded invidiously, it is merely put forward as a sound basis for the rational assumption that, however plastic, however inventive and constructive the genius of the man Stephenson, it was a genius which, in comparison with that of James, was untaught, unschooled, and undisciplined. In its flights it had not the advantages of experience, and was, therefore, compelled to narrow its circles as it soared; while, on the contrary, the more practically and scientifically educated intelligence of his new *friend*—so William James may with truth be styled—as it elevated itself to the regions of high-class theories, expanded its vision, ever enlarging its sphere the higher it mounted, and thus insuring greater facility of discovering in the material world the elements upon which it could but realise its conceptions. George Stephenson possessed, perhaps of all other men then living, the strongest predisposition for mechanical studies. His mind was cast in a scientific mould. His nature had graven upon it in broadest characters the mystic word Science, and it could not respond to any avocation—the least as the greatest—that some of its indicative letterings were not prominently exhibited. From the day when a mere lad he taught a great dog to "bring his dinner daily from Walbottle Colliery to the tramway," and mended clocks, watches, and old shoe-soles, to that when, in July, 1814, he turned out his first tram-engine, "My Lord," for Lord Ravenswoth, he evinced a tendency and tact, a combined power of ardent inclination and an ability indomitable and unswerving to bend and mould everything within his reach to those uses the necessities of his position suggested; but ambitious to get forward, and unfortunately not in circumstances to command sufficient time to leisurely ponder upon his own scientific theories, George Stephenson was, as it were, impressed into the service of others as a powerful imitator and astute improver of machinery already in colliery use. In his hands none will deny the secondary creation excelled the primary; and so quick was he in seizing every archtype that presented itself, and the manipulating of which would bring him into notoriety, he so *super-invented* on that memorable invention of Sir Humphry Davy, the safety-lamp, that at a meeting held Oct. 11, 1816—John George Lambton, afterwards Earl of Durham, in the chair—convened by the coalowners for the purpose of rewarding Sir H. Davy for his valuable discovery, the self-taught workman was put forward to contest the question, "Whether the merit of the invention of the safety-lamp was due to Sir Humphry Davy or George Stephenson?" The amendment moved by the Killingworth people was rejected by an overpowering majority, but eventually a purse of one hundred guineas was voted to the closely-imitative Stephenson.

To deprive a scientific opponent of a single element of the credit justly appertaining to him would not be a means which the high-principled William James, were he now living to assert his own cause, would have recourse to; and those events in the life of George Stephenson are thus truthfully treated, in order to show how largely in the dawn of his fame and fortune he was indebted to the designs of men already eminent, and how boldly, not to say unscrupulously, he impressed them into his service, moulding thus missiles, from material levied on friends and foes, to fling back in competitive defiance at them. A case in point is proved upon this allegation, that William James, on the first introduction of George Stephenson to him, when he visited Killingworth, finding him a man of wonderful readiness of perception, disclosed to him his long-cherished project of increasing the velocity of the locomotive, which already reached a maximum of six miles an hour on the tramroad, to such a pace as would meet his views of establishing railway lines for passenger traffic through all England. This is not advanced as a mere probability. William James is described, by those who knew him best, to have been a man "endowed with a great and noble soul, a generous and unselfish nature." Frankness was then natural to him, and now, when he conversed with an individual whom he regarded, and justly, as a great though untaught genius, and one whose services he, no doubt, would have desired to secure in the furtherance of his contemplated undertaking; an opportunity seemed to offer for its exercise in a business way, the more so, as his common sense must have suggested, however delusively, that no act of the person he conferred so openly with could injuriously assail the independent social position he had won. James gave way to the impulse; the shrewd and wary Stephenson heard respectfully and silently, or only put those leading questions through which he managed at length successfully and adroitly to, in vulgar parlance, "suck the brains" of his condescending visitor. Neither did he lose time in applying the knowledge he thus received—its preciousness was soon made publicly apparent. The unsuspecting William James had fallen into the snare, and lost that all to which, for many years, his mental and physical energies had been devoted; while George Stephenson, the freebooter on his design, sordidly and uncompromisingly grasped all the *spolia* of which he had insidiously dispossessed him. Enough has been said to point the moral we require. From this time, owing to the financial crisis which had occurred, the life of William James became chequered with business vicissitudes. *Fortuna non sapienta vitam regit* (Fortune not Wisdom governs life) seemed to be a proverbialism thoroughly borne out by the adverse changes which, despite all his prudence and exertions, daily occurred to mar his projects and cloud his prospects. Persecuted by a member of his family, to whose union with his sister he had shown himself sternly adverse, and who, in revenge, came upon him in a moment of temporary difficulty for his portion, the Rhadamantine laws of the period consigned him without much notice to a prison. The King's Bench—*now* in evidence our civilised progress closed against the unfortunate debtor for ever, mewed him within its walls; and while there, as invariably happens to the incarcerated, those interests which he might have resuscitated and strengthened for the benefit of his creditors, were ruthlessly invaded. It is not our province to enter into a legal research with reference to proceedings long past, in which the property of Mr. W. James was adjudicated upon. *En passant*, the conviction forced upon us by the valuable matter-of-fact evidence of the work intituled "The Two James's and the Two Stephenson's," may be recorded, that had his estate been managed with common honesty or prudence—had it, in truth, not been sacrificed—the results to his family would have been, comparatively speaking, an independence instead of *nil*. The head and hand which compiled effectively and with such right-mindedness, the little *brochure* referred to, will not weary in this just cause, but "go on and prosper." False friends, among whom may be mentioned one Joseph Sanders, or, as his deceptive and base conduct would warrant us to call him, a *Joseph Surface*, taught him now that severest of the most severe lessons life "in the world" can teach us—namely, that ingratitude in rough weather rises to greet one much sooner than kindred sympathy.

The limits of the space we are at present able to devote to the claims of the late Mr. James preclude the mention of very many enterprises, projects scientific discoveries, circumstances, and details wherein he was engaged, which, even had he not been the benefactor he was to the industry of the country in his large development of its coal and other mineral resources—to its commerce, in his extensive surveys and formatian of roads and railways—to its science, in designing for steam-engines on railways greater powers of velocity, to suit his favourite plan of *passenger traffic*—finally, to society in general by the improvement of its physical state in promoting a system of drainage, which still insures the most important sanitary results, not only to our own metropolis, but both at home and abroad to other thickly-populated localities—and, in a high psychological sense, through that moral influence of Christian principles and high intellectual refinement he brought to bear on all his phases of public and private intercourse with the world—would cast a bright halo around his memory, to which the eye might admiringly be turned for example and instruction. There is no use denying the fact that the decadence of one man is the elevation of another in the great competitive sphere. James undergoing the horrors of what proved to be, but too late, an illegal confinement in a debtor's prison, had to resign his interests to the tender mercies of others; and they seem to have financed their trust for their own immediate benefit, and sold them to the highest bidder, who was no other than George Spephenson.

A truly unhallowed task would it be to search amid the moulderings of the grave for those proofs which would inevitably, and it might be thought invidiously, strengthen, to the deterioration of a great name, the plea of justice advanced on the part of William James. He and Stephenson are coffined to eternal rest, but their names live. Finally, the latter, it is contended upon what appears to us good and sufficient grounds, was, in the particular instance which entitles William James to the patriarchal and honoured appellation *The Father of Railroads*, but the ingenious and crafty workman of the first designer.

Such is the essential fact, such the veritable verdict which reason, according to the evidence, positive and circumstantial, adduced, must return. Prejudices, as in every case of this sort, will be aroused to garrulous—mayhap, envenomed—action; but, say the advocates of the Jamesonian claim: we abide the issue of such question; we fear not the truth, lift the universal pall, and let the full light of that truth rest upon the face of our dead, and dwell there for ever. For ourselves, in mooting the subject we own to motives a little more mundane and material in their consequences than the mere settlement of this matter upon its merits in favour of one or other of those departed Worthies. Now, it so happened when William James died in Cornwall the fortune he had amassed was *dissipated*, it may be said, in the scientific and productive service of his country. The finacial system introduced by the late Sir Robert Peel had given the fabric he had raised the first shock—a fatal one, for, as the old Flemish architect said of the Arden Castle of Cravecœur, it was too large for propping, and it fell; worse than that, with it toppled down the fortunes of those who had the nearest and dearest claims upon heart and hand. Nothing is more painful and difficult than the struggles of a respectable family to hold their heads above those dark and sullen waters of adversity that flow upon them over the ruin of home. *The Father of Railroads*, William James, has still a worthy representative among us. His son, W. H. James, C.E., may truly be said to have inherited the engineering abilities of his father, and his invention of the tubular boiler, if he never had established any other claim upon public gratitude, ranks him with the most prominent of those who have a right to style themselves the scientific and commercial benefactors of their country. The record of his many contributions to science is long, and, therefore, we must, in justice to him, defer it for special notice to an early day; yet we may here assert that no man's claims on the Government and people of Great Britain, whether we regard all which he inherited from his eminent father, or has founded by his own honourable and intellectual exertions, can be stronger than those which Mr. W. H. James has, and we hope will impress to his benefit, though at the eleventh hour, upon our national sympathies. The family of Mr. James seek not the "bread cast upon the waters;" but we hesitate not to demand for them that appreciable recognition which shall enhance the comforts of life in declining years—that which is *just* in a great country, and ennobles its recipients.

ANNUAL MEETING OF THE MINERS' ASSOCIATION.

The annual meeting of the Miners' Association of Cornwall and Devon was held in the committee-room of the Polytechnic Society, Falmouth, on Sept. 24 and 25, when the following were among the company present:—Mr. Charles Fox, President of the Association, in the chair; Messrs. Enys, J. J. Rogers, R. Hunt (hon. sec.), R. W. Fox, Alfred Fox, Percival Johnson (assayer, London), Hearder, Hustler, Cady, Garby, Pengelly, R. Pearce (agent of the association); Capts. S. W. and T. Richards; Rev. S. Rogers; Miss Foster (Lostwithiel), Miss Carne, &c.

The Chairman, in opening the meeting, read the following address:—

A year having elapsed since we met here, it may be asked what has been done in the interval. Truly, nothing in the way of show. We have had our quarterly meetings, where valuable papers were read and discussed; new classes (of which your lecturers will give a summary) have been established, for numerous students, of whom some have passed a successful examination. If their papers are scanned, it will be found that there is no attempt to give them a dilettanti view of science, but rather an accurate photographic image of its elements; not a mere speculative idea of the composition of metalliferous substances, of the character and relative position of the matrix rocks, and of the local disturbances evidenced by veins, cross-courses, and slides. Not that in its appropriate time and place we would reject the theoretical view which may present truth more comprehensively, as Humboldt does, or artistically, as Rusken, who sees a flake of mica lying for ages in the depths of an ancient sea, and thence lifted with other flakes to form the inaccessible summit of the Matter Horn, which his magic pen tints with hues hardly less brilliant than those of nature. Your lecturers have not thus diverged from the immediately practical path. They teach the dry first principles of some of the pure sciences of mechanics, and of those laws of attraction (whether called chemical or not), and of those polar forces to which matter is subjected (if the plastic hand of the Creator have not constituted them its very essence).

Some of you heard last evening, from a mathematician and geologist (W. Pengelly) how one of these pure sciences, that of numbers, is exhibited with definite ratios, not in Babbage's wonderful calculating machine, but in animal and vegetable forms, and in the planets of our system; as he might also have shown that the sections of a cone, and the solids educed from them, rule with their lines of beauty, from the smallest living cell up to the great sun itself, and the orbits of its dependents; the visible expression of the infinite mind of Him who "made the stars also," "who telleth their number," which no astronomer can do, "and calleth them all by their names." Numbers and forms confront us everywhere, and must be studied, and so must the rocks which your students have to explore, the minerals which they lay open, and the economical separation of the contained ores, as well as the application of steam and water power, the relative fitness and the needful but not lavish power of materials to bear tension and shocks, not breaking from superfluous weight in one part and deficient strength in another. All our miners cannot know these things traditionally, or by diligent inductions from their own observations, or have had the opportunity of being trained in a school of practical men. The really practical man is he who by long-continued and quick observation avails himself in every direction of the fruits of laborious thought and experiments of previous generations. The inspired lawgiver says that Bezaleel "under the shadow of God," (as his name imports), was chosen for all manner of workmanship in gold, in silver, and in brass, because he was divinely gifted with wisdom, and understanding, and knowledge. This may be said in a modified sense of many later men, benefactors of their race. The sky of glass in the International Exhibition may be traced to the science of Abbot Benedict, who 1200 years ago brought into Sunderland the art of staining glass, and the improvement in its manufacture, which has continued there until now, to cover acres with a canopy of crystal, under which are innumerable proofs that practical men have availed themselves of all the means which the cornucopia of science has poured out.

Men in all ages have tilled the ground, have possessed herds of cattle, have washed their linen (when they had any), and in some way have protected their feet. But it is in this generation only that we see a perfect and most economical reaping machine, a cheap ploughshare, with a cutting edge always sharp, on the principle of the incisors of rats and rabbits, apparatus for washing, a milking machine, with which the neat-handed Phyllis can fill a bucket (in no danger of being kicked over) at the rate of a gallon per minute, and a machine for making good shoes cheaply. Sir Isambert Brunel, descendent of the great artist Nicholas Poussin, by his shoe machine helped men to walk before his son enabled them to run, or rather fly, on the rail from London towards this port; where his father came in, that he might visit a country capable of casting two iron cylinders which he had seen when a little child on the quay at Rouen.

Your honorary secretary's Hand-book of the Industrial Department of the Exhibition (where, as a swift-footed Mercury, he had to arrange and describe the works of many a limping Vulcan) tells of metals, minerals, and machinery interesting to this association. Our western minerals are not imposing there, but they may serve as samples of the vast specimens, or as logarithms of the enormous amounts of gold, silver, &c., which your miners have been the principal means of raising from British colonies, Brazil, and the Spanish part of the New World. Arthur Dean, who planned the draining of the Haarlem Lake by the engines of this country, was the first to discover gold in the lower Silurian strata near Dolgelly. The large lump of quartz from thence, studded with gold, is a British novelty in the Exhibition. The produce of those Vigra veins contrasts with that of many auriferous washings: the six millions of tons washed in a year in the Ural Mountains producing but little more than 5 tons of gold—the copper mines 5000 tons. Capt. Hunt's Jigging Machine, exhibited in London and here, may be very economical in the washing of poor ore.

The model of Stamps worked by a turbine gives a useful hint for utilising a stream of water small in quantity but with a considerable fall. But, to thousands, a then living miner in the Exhibition was more attractive than models, or the marvellous platina bowl of Deville—a genuine English frog, staring with brilliant eyes, out of a block of coal, at the classes of the upper world. I suspect that he must have been a very small miner when he descended into the carboniferous strata, without even a pasty in his pocket. If we were to discover a supposed Phœnician in the rubbish of an abandoned mine, and found coils of Bickford's safety-fuse, and tobacco, in his jacket, we should suspect him to be one of our own countrymen. To you it is needless to say how opposed to all analogy would be the finding of even a fossil English frog or toad in strata below the great extinct Saurian, in which there are wonderfully few fossils identical with recent species. Moreover, on some of the coal measures marine deposits lie above those from fresh water, vast deposits of lead in veins, as at the Great Minera, and molten trap would not improve the sanitary condition of any animal. The plan and sections of a level driven seven miles by W. B. Beaumont to unwater and open out his lead mines, remind one of the great adit in Gwennap: and that such works, or the sinking of a large central shaft, for the unwatering and working of several adjoining mines at greater depths, would require leases of more than 21 years, and a large association of adventurers. The very valuable Freiberg mining periodical shows the perseverance of our German friends in the completing of long adits before and since the use of powder in blasting was practised. One in the Oberharz, carried on at intervals through the last eighty years, is more than 10 miles long, the last two at a cost of about 4*l.* 10*s.* per fm.

The treasurer's report will show how small are our means for a much less herculean work, and that there is a great deficiency of even necessary funds. Your honorary secretary had such pressing duties at the Exhibition, that he has not been able to direct his efforts to increase the number of subscribers, and many of the larger mines have not yet responded to his appeals. Our revenue is really not greater than the cost of sinking a winze or two.

One may fancy Old Wheal Abraham and Crenver Mines groaning, *de profundis*, that a skilful rope dancer over their graves should obtain in an hour more than you have annually to spend for the instruction of your students, and for promoting the bodily and mental power of your diligent, careful miners, and for thus strengthening the fragile thread on which their lives hang. But Botallack may be jubilant in her black precipices, that in the busy hive of St. Just a young Prince puts on a miner's jacket (unlike the imperial pilgrim who doffed his regal robes for a monk's dress in another St. Just), not building castles, like his great namesake, on the craigs of Tintagel, but descending

> "Under the whelming tide,
> Visits the bottom of the monstrous world,"

not to "Sleep by the fable of Bolerus old," as Milton laments, but to observe at the depth of 200 fathoms our living Celts as they work under the Atlantic with the bars of the earth about them,—

> "So sinks the day star in the ocean bed,
> And yet anon uprears his drooping head,
> And with new spangled ore
> Flames in the forehead of the morning sky."

Our gracious Queen might have named her beloved young Lycidas (if of riper years) amongst her mine commissioners, to whom none can refuse the merit of patient investigation by innumberable enquiries amongst all classes, by frequent descents into mines, and by medical and other probings into the condition of the men. I greatly fear that their researches have not disproved the absolute mortality of miners' children, although there may have been an error in taking the ratio between it and the numbers of the living, nor justify any supineness on our part by showing that a miner's life is a healthy one, even if his early death arise rather from a failure of the vital powers to resist disease than from true tubercular consumption. Whenever their report may be made, it will contain a long array of opinions as well as of facts, and much that is suggestive to stimulate us to "be up and doing."

I was recently in the cotton district, and observed how suffering has brought tens of thousands into more intimate relations with their employers; families are visited, and the want, or sickness, or ignorance of individuals is sympathised with or alleviated. Would that in our mines, now blessed with prosperity, something of this individual work could be accomplished. A captain is dictator of a republic; he should know all its citizens, and should watch against the first departure in them from moral or physical well being. As the mines are sunk deeper, economy at least must compel a more extensive use of the man-engine and the skip, the selection being determined by local causes, if not local preference. Their comparative efficiency has been ably treated in the "Mining and Smelting Magazine." But whatever the relative expenses and facilities may be, the skip would seem to require a more constant attention to mechanical details and more checks to the daring of the men. The papers on the explosion of boilers which you have had presented to you in the year, gave both facts and suggestions on this vital subject. Vital, because an explosion often endangers the existence of a mine, and almost always always destroys life. I have on a former occasion referred to the accidents prevented in Manchester by a regular inspection. Happily, in Cornwall and Devon greater care has long been exercised than in the coal districts, where before the law made it imperative there were no steam gauges. Mr. J. Dickinson, the Government Inspector, has lately said—"There must be causes in all explosions, and the sooner they cease to be looked upon as mysteries, the sooner will the true causes be ascertained." He gives the Belgian legal formula, with thickness of boiler plates, which is greater than that of English boilers, at least in the North. In connection with this is the law of expansion of superheated steam, as communicated to the Royal Society by Fairbairn and Tate. In ventilation we are not advancing, except that there is a more prevailing conviction of its importance. I would suggest that experiments should be made in levels (where powder smoke hangs), with gun-cotton prepared on the spot, a wooden wedge and a cleft stick above being placed on the cotton, and then a tamping of loose sand. Many kinds of safety-fuse are daily under the observation of practical men. We watch eagerly for a general expression of opinion from impartial judges as to which may combine the greatest certainty of firing the powder with the least danger. Would not many accidents have been prevented if Sir Humphry Davy's tamping bar had been used instead of those of iron? In the manufacture of this *sine qua non* of mining, and in all human industry, what progress is being made. Those delicate chemical changes which an exquisite chemical analysis pourtrays but imperfectly, may make it a home for magnetism, the hair spring of a chronometer, or the trustworthy wire rope; a chain broken by a shock has most of its links weakened, as a man is by a fall when he breaks a leg, but the wire rope, especially when of steel, is lighter, and does not sustain like concussions. In rails, which enormous loads are constantly laminating, iron in its altered form is now being used. In boring holes by other than human power for blasting we are doing nothing. Whatever success may have attended Crease's experiments in the Clogau Mines, or of Schwartzkopff in Germany, I have not yet heard. Let us bear in mind that the force of the borer is *cœteris paribus* as the square of its velocity, that the speed of the miner's mallet is necessarily limited, and that he cannot strike even with many intervals of rest, one-seventh times as many blows in a moment as a machine, the cost of the motive force, even in a large mine, as I have often maintained, being trifling. Night shifts might generally be avoided if the effective work of a miner could be doubled; he could become a skilled labourer instead of a "jumper," and his whole frame be relieved. One has but to look at the rich products in the Exhibition of the copper mines of the antipodes to be convinced that necessity will sooner or later compel us to use underground brains more and muscles less, as the spinning jennies have superseded the distaff.

I have not lately visited the class-rooms, and do not know if any additions have been made in geological books and maps, sections of mines, drawings of machinery, and above all specimens of rocks and lodes collected by the students, and rightly named; until this is done some of their acquired knowledge will be necessarily vague.

There are very many intelligent agents of large experience who could delight their hearers if they would make a tutwork or a pitch the subject of one or more evening lectures. Faraday still instructs by a lecture on a candle,—what might not a whole bunch of our consuming smoke-producing candles do? There is also the powder, the fuse, the iron and steel of their tools, the rocks and minerals of the level, the character of the ore, the cross-course which heaves it, the warm water which rises through the fissures, and the joints and cleavage, which no miner can overlook with impunity. How richly could such men illustrate their remarks by a comparison with similar facts in other districts, and dwelling on those which are exceptional.

Mr. Salmon's "Mining and Smelting Magazine," by its valuable extracts from French and German treasures of Mining Records, and the Spanish Revista Minera, and by sketches from time to time of mines peculiar in their characters, assists the reflecting miner, and enables him to place his hand on sources of information on particular points. Whilst we try to lessen the cost of obtaining ores, we should also seek to convert profitably those of the lowest produce. One cannot hope that the poorer sulphides will give, in the best process, such commercial results as the cupriferous sandstone of Alderley Edge; its picturesque wooded heights appear to be the edge-shattered ends of the new red sandstone, of which the strata have been raised to a high level. What a new scene to a Cornish miner to enter a great quarry, and instead of a lode to see beds of sandstone 60 or 70 ft. in thickness, coloured blue and green by copper ore, with a thin floor of cobalt lying above, and a great deposit of lead in juxtaposition; a vein of barytes seemed to intersect the whole. My conductor (Mr. J. Mitchell, jun.) selected for me some of the specimens before you, accompanied me down the incline of the bed into the long galleries, which are quite dry, and was entirely at home in his underground lecture; the skilful energy of his uncle knows how to utilise profitably by the aid of chemical science, which has been clearly described in the *Mining Journal*, these copper ores of 1 per cent. produce to the extent of 20 tons of oxide of copper monthly, in addition to the cobalt, nickel, silver, and lead; such produce would almost escape the dry assay. Similar deposits overlaid by trap are said to exist in New England; they show in what a novel character workable deposits of minerals may be presented to the young miner, where he may be entirely at fault if he relies on merely local experience, without sound elementary knowledge.

Time passes, or I would speak on some other subjects, such as the duty, whilst we employ females on mines, of seeing that the younger ones are taught, and that some, at least, of the older ones are instructed in household duties. On the danger of paying the men in notes, where they can change them only in the public-house. On a better provision being made by local hospitals for sick or wounded miners. I would suggest that weekly mining reports, when giving the value of the lode in the end, would also state the cost of driving it. And the bi-monthly accounts might give the amount of tributers' ore sold, distinct from the adventurers'. In conclusion, I would say to our working miners (in the words of a great authority), "There is scarcely anyone of the powers or faculties with which the Divine goodness has endowed his creatures which may not in its turn be a source of paramount benefit and usefulness; for everything around us is full of blessings; nor is there any line of honest occupation in which we would dare to affirm that, by a proper exercise of the talent committed to his charge, an individual might not justly advance himself to the highest praise for the greatest service."

Mr. R. HUNT said—Sir, it now becomes my duty as the hon. secretary of this association—an office the duties of which this year, I must say, have been very ill and inefficiently performed on my part—to make some statement regarding the progress and position of the Miners' Association of Cornwall and Devon since our last annual meeting. In some respects, nothing could be more satisfactory than that progress. One great problem has been solved, and it is one about which I felt peculiarly anxious at the commencement of the association—the desire and feeling of the miners themselves at the prospect of being supplied with education and instruction in branches which bear didectly on their means of bread-getting. We have now 10 classes who are receiving this instruction, and, if we had had the funds, these 10 might have been 20. We are, in fact, only limited with regard to the number of our classes and the persons receiving instruction through our association by the amount of the means at our disposal to support these classes. The classes which have been receiving instruction during the past year are—1. ST. JUST, which has, I believe, been in existence since the establishment of the association, and, indeed, before that time. In this class chemistry and mechanics have been taught; the students continue the practice of assaying, and the class is regularly visited by the chemical teacher. 2. MARAZION.—Chemistry has engaged the attention of this class of young miners. 3. HELSTON.—A course of lectures on chemistry has recently been delivered to 27 students. They still continue, under the direction of a member of the class, experimental chemistry and the blowpipe. The secretary of this class will furnish some interesting information respecting it. 4. ST. DAY.—This class, consisting of 16 students, has just completed its first course. 5. REDRUTH.—Chemistry and mechanics have been the subjects of attention. This class is engaged in the regular practice of assaying. 6. ST. AGNES.—Chemistry, mechanics, and surveying have been regularly brought before this class. They meet regularly, and Mr. Pearce visits this class once a week. 7. ST. BLAZEY.—Chemistry and surveying have been taught. This class applied for the aid of our teacher of mechanics at an early date. 8. CROW'S NEST, near Liskeard.—This class consists of 32 students. Mr. Twite has been lecturing on mechanics and surveying, and the members have now formed themselves into a class for mutual instruction. They meet regularly once a week, and lectures are given. Mr. Pearce will visit this class in a very short time. 9. GUNNIS LAKE.—A very interesting class has been formed here; surveying has been carefully studied, and now they are preparing themselves for the more advanced study of mechanics, by meeting for the practice of arithmetic. 10. TAVISTOCK.—Surveying has been the study in the class here. Arrangements will be made for Mr. Pearce to visit this class shortly. So that we have now 10 classes, extending over the counties of Cornwall and Devon, in active operation. Several other places are making application to us to open similar classes; but, as I said, our means are limited, and we cannot extend the number beyond what are at present established, unless we are supplied with additional means. These classes have been supplied, the teachers of chemistry and mineralogy, and of mechanics and surveying paid, together with their very heavy travelling expenses, and several of the class-rooms have been supplied with apparatus and chemicals by the Miners' Association, with an income of less than 300*l.* per annum. Now, the small cost at which such a really large amount of good, as I believe, has been done really surprises me, and must surprise everyone acquainted with the subject. Mr. Pearce has placed in my hand a letter which has been received from Mr. E. Stanley Poole, the chief clerk of the Science and Art Department of the Committee of Council on Education, in which he writes:—"I am directed to call your attention to the free admissions and royal exhibitions of 50*l.* per annum for three years offered by the Royal School of Mines to candidates, and to inform you that there are at present four of each vacant. I am, therefore, to request that you will inform me if any who were candidates at the late May examination desire to make use of these. Upon the names being sent in, the four who stood highest at the late May examination will be selected. The session will commence on Oct. 6; the names must, therefore, be returned as soon as possible, to be of any service." So that any of the young men, students of our classes, who passed the examination in May last in the Department of Science and Art will be eligible for these scholarships of 50*l.* a year, and will receive their education from the professors at the Institution in Jermyn-street. In addition to these, there are the Queen's and the Duke of Cornwall's scholarships, which are open to the students of our classes. And here I cannot but avail of the present opportunity to express my real surprise at what I would call the "educatedness" of the young men in our classes. The aptitude which they have shown in the acquisition of knowledge in chemistry and mechanics is such as I will make bold to say could not be exceeded by the young men of any other country. The advance which has been made in these sciences in a few weeks in the classes which I have visited has been something really extraordinary; and the desire to gain information by the young men throughout this and the adjoining county has been more and more strongly evinced as they hear of the progress which has been made in other places. We have, for instance, applications for the establishment of a class at Breage, of another at St. Ives, and I trust that in a short time we shall be able to extend our operations to these and other places. The experiment has now been tried for two years, and the result is that we have now 130 students receiving instructions in our classes, and we might, as I have said, have double the number. We have, however, gone to the limit of our means; but, of course, with additional means more good could be accomplished. Owing to the intense application which I have had to give to other matters during the year, I have been prevented from performing a great portion of my duties as the secretary of the association, and among these duties was one to which I will now refer. By a minute passed by the council at the commencement of the year, I was directed to make application, by circular, to mine agents and others interested in mining property, soliciting their co-operation and support on behalf of the association, but, with few exceptions, I am sorry to say, I have neglected to do so. It is, however, my desire and attention to follow the direction, and I shall issue a circular letter to mine agents and others interested in mining, soliciting subscriptions in favour of the object which we desire to carry out, and I would now urge upon the gentlemen present the importance of aiding us. By this means, I hope we shall obtain an addition to our income, which now only amounts to something under 300*l.* per annum, whereas the association cannot really be efficiently and successfully worked with anything less that 500*l.* a year, and if even an addition to the latter sum could be obtained it would be a great advantage. (Hear, hear.) Mr. Fox has directed your attention to the importance of furnishing scientific education to the young miner, and nothing further need be said by me on the subject beyond this—that the want of this education is sufficiently shown by the conduct of the young miners themselves, and the avidity with which they embrace every opportunity we have been able to afford them of obtaining it. (Hear, hear.) There is one thing in which we have felt there has been a failure; but I am now in hopes that in a short time we shall be able to progress in that direction as well as in others. One portion of the scheme of the association was the bringing of mine agents together, and endeavouring to persuade them to record the results of their observations and experience. Every agent of talent and observation is continually learning from the facts which are brought under his notice in the course of his daily avocations, truths relative to the phenomena of nature, which, if recorded, would be of the utmost advantage to everyone engaged in mining industry. The lives of such men pass, and passing away from us the results of their experience are wholly lost to us in consequence of their being unrecorded. Now, it is of the utmost importance to get these observing men to record the results of their experience, and thus to afford us the advantage of them; and, in addition, it is suggested that, by thus uniting a series of well-digested observations—and I trust that by the education which we are giving to young miners we shall teach them to be closer observers of whatever may fall under their notice which is likely to be of advantage in the branch of industry in which they are engaged—I say it is suggested that by thus uniting a series of well-digested observations, we shall by-and-bye advance towards a knowledge of those laws which regulate the deposition of metallurgical veins in our earth. (Hear, hear.) You may depend on it that these deposits are guided by a law as certain as that of the rise and fall of the tide, and I am certain we may arrive at a knowledge of this law if mining agents will only record the results of their observations. (Applause.) I would take this opportunity of impressing on these parties and all others who are engaged in mining operations what is being done in other parts of the kingdom, as showing the importance of their adopting this plan. I may refer to the Mining Institution of South Wales, the members of which are furnishing a series of excellent and most important observations for the benefit of those who are engaged or may engage in that branch; also to the Mining Institution of Durham and Northumberland, which is furnishing reports that would be a credit to any association in the land; and I feel that mine agents here have only to adopt the same plan, and we should obtain reports equally valuable. On this point I do most earnestly solicit the co-operation and assistance of all those agents and gentlemen connected with mining. (Hear, hear.) Mr. Fox has alluded to the formation of libraries in connection with our class for the benefit of young miners. Such libraries have not been formed as yet, but I trust they will be; and I feel pleasure in mentioning an offer that has been made to us, and which I trust will be the neucleus of a library in which will be gathered such works as those that have been referred to by our President. Mr. Salmon has kindly offered to supply bound volumes of the "Mining and Smelting Magazine"—a periodical that contains a large amount of valuable information on mining topics—to the association, for the benefit of the members. (Applause.) The papers contributed to the association will, of course, be forwarded to the classes, and these will form a very valuable collection, and the classes are also furnished with chemicals and the apparatus which they require in their studies. I have received a communication from Lord Kinnaird, the chairman of the Government Commission that has just been enquiring into the state of the mines and mining in this and the neighbouring county, enclosing a resolution passed by them, and, as I know it will be of interest to the miners of the county, I will read it:—"Bedford Hotel, Tavistock, Aug. 12, 1862. Resolved—That the thanks of the Commission should be conveyed to the various witnesses in Cornwall and Devonshire for the readiness with which they have attended before them to give evidence, and the valuable information which they have communicated." I know that there are many different opinions entertained with regard to the value of this Commission and the probable results to be derived from it; but, however that may be, one thing is certain, that we shall receive a large amount of information, carefully and industriously collected together, which we could not otherwise have obtained. Lord Kinnaird is certainly most anxious to arrive at a true solution of the problem as to the causes effecting the health of miners; and he has recently called in at his own cost, and entirely independent of the Commission, Dr. Angus Smith, who is well known in connection with his analysation of the water and air of towns, to analyse the water and air of certain mines. We know that there is something connected with mining operations which tells on the health of miners—that there is a certain class of diseases which belongs especially to the miner; and every one of us possesses feelings of humanity sufficient to lead us to desire that endeavours should be made to ascertain and determine the source of these diseases—whether in the labour of climbing up the shafts of mines, to defective ventilation, or to whatever other source they are attributable. I believe that it will be found that they are not owing merely to the accumulation of carbonic acid gas in the mine levels, but to there being a certain and undue amount of oxygen in the air which miners breathe. These are some of the facts which I trust and believe will be elicited by the Commission. I am not aware that there is anything else to which I need now allude; and in conclusion, I will refer to the frog which Mr. Fox noticed as having been buried for years in a block of coal. Poor froggie is now dead; and as a superintendent of Class I. in the Exhibition, I certainly deserve some blame for allowing him to be exhibited there. A correct statement of the way in which froggie was found has not yet been given. He was not found in a block of coal, as has been stated, but on cutting or breaking up some coal the roof of the building in which it was placed came down, and master frog was found among the shale afterwards. We can very easily imagine how he may have got there. Before sitting down I will now once again most earnestly ask for the assistance of the gentlemen present, and the ladies also, in the endeavours which we may make to increase the funds of the association.

Mr. R. PEARSE then read a report from Mr. Edward Horswill, giving an account of the proceedings of the classes established in connection with the Miners' Association at Tavistock and Gunnis Lake. From this it appeared that the class at the former town numbered 10, and that at the latter 20 members. They met twice a week, the subjects studied being arithmetic, elementary chemistry, mineralogy, dialling, &c., the students evincing an anxious desire to master the instruction afforded. Mr. Pearce observed in conclusion that considering the short time the students had been under instruction, the progress they had made was very creditable.

Mr. HUNT said that he ought to have added that the number of students who would have passed the examination in May would have been much greater but for the circumstance of the Department of Science and Art requiring that every student should have attended 40 lectures by the agents of the association. Owing to the engagements of Mr. Pearce and Mr. Twite it was impossible for them to have given the requisite number of lectures to the students of the various classes; but now that the regulation of the department was known it would be complied with in the case of those students that might go up for examination at a future time.

Mr. CUNNACK gave some information relative to the class that was established at Helston. He said that it was formed in March last, and although they were situated between two mining districts, and the members had to walk two or three miles to attend the meetings of the class, yet the attendance had been very good. Many mine agents in the neighbourhood gave the class their support, and he believed it would be continued.

Mr. HUNT said that there was another matter in which the officers and council of the association had entirely failed in their promise to the public; and they must this year make an effort to carry it out. When the association was formed, a quarterly or annual report was promised to the members in return for their subscriptions; and though he knew that many of the members required no further return for their support than the consciousness that they were engaged in a good work, yet he was aware that in this world men generally did require some return. They had had a few copies of the papers which had been read at the meetings of the association printed, but this was not enough, and it was highly desirable that they should issue reports periodically. Now, the mention of this matter afforded another proof of the necessity for an increase of the income of the association, for, from his experience in connection with the Polytechnic Society, he knew that they would incur an expense of from 80*l.* to 100*l.* a year by the printing of a report; but they could not do that unless their income was increased, and he trusted that the miners of Cornwall and Devon would not provide them with the means to carry out this, their original intention.

Mr. CADY said that while giving evidence before the Commission on the subject of drawing stuff from South Wheal Frances Mine, he was requested to state the cost under the old and new systems. He did so, extracting the figures from the books of the mine, and as they might be considered a continuation of a paper on the subject of drawing, which he read at a former meeting of the association, he would now read to them. The wire-rope now in use was put on in July, 1857, and for the five years previous to that date the cost of chain, kibbles, &c., used was 1142*l.* 1*s.* 2*d.*; estimated cost of repairing shafts, stands, &c., 300*l.*; smith's cost for ditto, at 50*s.* per month, 150*l.*: total, 1592*l.* 1*s.* 2*d.* For the five years ending July, 1862, the cost of the wire-ropes, skips, &c., had been 773*l.* 10*s.* 1*d.*; repairs of shaft, 25*l.*; depreciation of stock, &c., 75*l.*: total, 873*l.* 10*s.* 1*d.* During the former five years the ore sold amounted to 20,836*l.*; and during the latter five years it amounted to 21,564*l.* In addition to these results, which were so much in favour of the new system, he put the number of men drawn up by the wire-rope and skips at 40 per diem, or 1300 per month, which he calculated as equal to 780 tons per annum, or nearly 4000 tons for the five years.

In answer to questions from the Chairman, Mr. CADY stated that during the five years prior to the new plan being adopted their power was hardly equal to the work required to be done, whereas during the last five years the power was equal to much more work than had been required to be done. The shaft was not a perpendicular one, but had an inclination to the north at a certain depth. They had Bennett's patent springs to the skips, and he considered that it would be unsafe to employ skips, even with these springs, unless there was also a break to the engine.

Mr. PERCIVAL JOHNSON said that he had listened to the observations that had been made by the Chairman and Mr. Hunt with great interest, and there was one matter that had been referred to which appeared to him to be of essential importance—the ventil tion of mines. He thought that the association might be of essential service in directin attention to, and disseminating information on, this subject. He believed that it would b easy to prove that the ventilation of mines had generally been conducted upon a wro principle, that of forcing fresh air down the shaft into the workings, as it was more difficu and took a longer time in supplying the quantity of fresh air required by this plan th it would do to pump the foul air out of the mine. Some years ago he made an experi ment on the Tamar Mines, which, as they were aware, extended under the bed of th river, and the principle he adopted was, instead of forcing pure air into the workings, t exhaust the foul air therefrom. He merely used a fan machine on the principle of Clarke blower, which was worked by a water-wheel, and the plan was found to answer admirabl

An interesting paper was then read, partly by Mr. Hunt and partly by Mr. Enys which was contributed by the latter gentleman, on the quantity of power exerted in th junction changes at Beachy Head, compared with the intensity of the junction chang in the rocks of several headlands of the coast of Cornwall. Mr. Enys also exhibited number of maps in illustration of his paper. We shall refer to the latter on a futu occasion.

Mr. PENGELLY confirmed from his own investigations and observations the correctne of the views expressed by Mr. Enys in his paper; and the latter gentleman said that h had been much gratified with what Mr. Pengelly had done on this subject, he havin ascertained that which Sir Henry de la Bêche had failed in doing.

The CHAIRMAN than exhibited some specimens of the carbonates of copper in sandston which had been obtained at Alderley Edge, in Cheshire.

Mr. HUNT explained that these deposits were derived from the decomposition o mineral lodes in the immediate neighbourhood.

The Rev. S. ROGERS, refering to the remarks of Mr. Hunt as to the importance of min agents recording the results of their observations, asked whether, supposing the associa tion were to issue blank sheets, with printed headings, to the agents, it would not be co means of obtaining what they required?

The CHAIRMAN thought that it would be desirable to adopt this suggestion. Som years ago his brother, Mr. Robert Were Fox, had in this way submitted certain question to the mine agents in the county, and elicited from them very valuable information.

Mr. HUNT said—These remarks lead me to allude to one matter on which I have fe an immense amount of difficulty. From the first moment of my mooting the questio of a Miners' Association, my aim and object has been to make it really such. For som time, however, I have been constantly met with this objection—your association is no a Miners' Association, but an association formed by gentlemen over the county—ve well meaning in their way, and offering to the miners a certain amount of educatio which the miners do not require. Now, to the latter part of this objection we hav given an answer, or rather the miners themselves have done so, by showing unmistak ably that they do require the education we have offered them; but I feel that the pe manent success of the association depends entirely on our being able to make it an ass ciation worked by practical miners, and although twelve months ago you suggested th a series of tables or questions should be circulated with a view to obtain certain info mation, I have not done so, owing to the impression which I felt that there was a feelin of jealousy among miners that we were interfering with matters which belonged to them selves. During this time, however, I have been in communicating with mine agent with the view of inducing them to start such a series of questions themselves, they bein perhaps, the best judges as to the form in which such questions should be put to b answered by their brother miners. This it is which has prevented the sending out o such queries as those made by Mr. R. W. Fox a few years ago, and to which such valuab answers were returned. We are endeavouring to give to young miners such informatio as will be most valuable to them through life, and also to interest the mine agents su ciently to induce them to record the results of their experience. I should be exceeding gratified if our friend Capt. T. Richards, and some other mine captains, would take th matter out of the hands of the association, and propose to their brethren a series of que tions to be answered, with the view of their being sent to the Miners' Association. M Hunt then proceeded to state that hitherto the working of the association had, thou a kind feeling, been mainly left in his hands, but as he was in London a great part of t year, he felt that he could not do justice to it, and it was, therefore, now proposed th an executive committee should be formed, to be composed of two or three gentlemen w would come forward and voluntarily offer to take the working of the association in their own hands, and thus assist the council by meeting once a month or six weeks. the last general meeting of the association it was determined that there should be on two quarterly meetings this year, it being considered that this was an exceptional ye and the first of these meetings would be in November next. It had been strongly urg upon him by persons interested in the success of the association that that meeting shou be held at Liskeard, and as the previous meetings had been held in the western and ce tral districts, it would, perhaps, be judicious to comply with the desire that had be expressed to hold the meeting in that town.

The CHAIRMAN: By all means.

Mr. T. RICHARDS: Having been connected with the Miners' Association from its co ment, I feel particularly gratified—and I am sure that everyone who has been prese when Mr. Fox has presided must have been equally so—at seeing him take so mu trouble and pains to enlighten practical miners as well as all others who have attend these meetings. I have felt from the first that the task which the association propos to undertake was a very difficult one; but, at the same time, I consider that the educ tion of miners is a most desirable object, and I think that after they have received t instruction which Mr. Pearse and other agents of the association are qualified to impa they will be better fitted to go abroad; and if you look to the various portions of t world at the present time, I think you will see that there is scarcely a known coun in which the Cornish miner is not to be found. While engaged in these countries knowledge of chemistry and mineralogy must prove very valuable to them; and I mu say that we agents would be better able to discharge the duties of our office if we po sessed a better knowledge of these branches. (Hear, hear.) I see no reason why mi agents should not support the association better than they now do. As regards o aiming at anything very scientific, that, I believe, was never thought of. Such mi scientific researches can be carried on by such men as Sir H. de la Beche and other but, at the same time, although these men have seen the changes which our rocks ha undergone, such changes have little to do with those changes which have taken pl in the bowels of the earth, which have not been exposed to the observation of scienti men. I consider that, owing to greater attention having been paid to the intersecti of rocks, miners during the last 30 years have had better means of ascertaining t barrenness of a rock or the richness of mineral deposits than formerly, and that is o of the points to be studied, so that miners may in future avoid labouring and expendi money where there is very little chance of obtaining a return for the outlay. Wi respect to the Miners' Association, the papers which have from time to time been re at its meetings, although not very scientific, have been highly practical, and in th much useful information has been given. When a man reads one of these papers he led to ponder and think, and when he does this much good will result from it. T being so, I had hoped that the association would have prospered to a greater extent th it has done. I feel deeply indebted to our President for the information which he h afforded, and I beg most cordially to tender him my best thanks, in which I believe eve one present will most cordially join. (Applause.)

The CHAIRMAN in acknowledging the compliment, said that thanks were more par cularly due to Mr. Hunt, who had taken the labour in connection with the associati off his hands.—The meeting then terminated.

The exhibition was re-opened in the evening, when Mr. Pengelly commenced a v interesting lecture, to which he gave the title of "Arithmetic of Creation," in which showed that the objects in any and everyone of the same departments of Creation h definite and constant numerical relations, and that these relations, invariable as they within the boundaries of anyone natural group of objects, vary in different groups.

On Thursday the hall was opened at ten o'clock, and shortly after company began arrive. The programme of proceedings for the day included a further description of t objects of interest in the hall, and the reading of papers which had been submitted the society in the committee-room. In the evening the exhibition was opened at ha past six, and at eight Mr. Hearder exhibited his specimens of Algæ, illuminated by oxy-hydrogen light, and his dissolving views of statues in the Crystal Palace. In ad tion to the above, a lecture by Mr. W. Pengelly, F.G.S., on the Brixham Cavern, a the discoveries made therein, was announced for the afternoon at the Royal Hotel.

These different subjects will be noticed in next week's Journal.

ASSOCIATION FOR THE PREVENTION OF STEAM-BOILER EXPLOSIO AND FOR EFFECTING ECONOMY IN THE RAISING AND USE OF STEAM.— At the last ordinary monthly meeting of the executive committee, held the offices, Corporation-street, Manchester, on Sept. 30 (Mr. Hugh Maso Vice-President, in the chair), Mr. L. E. Fletcher, chief engineer, present his report, of which the following is an abstract:—

I am happy to be able again to report that no explosion has happened during the p month to any boiler under the inspection of this association, neither has the occurre of any in other quarters come to my knowledge. During the month there have b examined 263 engines and 451 boilers. Of the latter, 15 have been examined special 6 internally, 72 thoroughly, and 358 externally; in addition to which 4 of these boi have been tested by hydraulic pressure. The following defects have been found in t boilers examined:—Fracture, 8 (1 dangerous); corrosion, 49 (8 dangerous); safe valves out of order, 3; water-gauges ditto, 14; pressure-gauges ditto, 4; feed-appara ditto, 3; blow-off cocks ditto, 16 (1 dangerous); fusible plug ditto, 5; deficiency water, 1; blistered plates, 3 (1 dangerous): total, 106 (11 dangerous). Boilers wi out glass water-gauges, 5; without pressure-gauge, 1; without blow-off cocks, 1 without back-pressure valves, 25. Two boilers have recently been met with, neit of which was fitted with its own separate safety-valve, but both were dependent o single one placed upon the steam-pipe, the communication between which and e boiler was conditional on its junction-valve being open, so that had the attendant at time inadvertently left this valve screwed down—on getting-up steam, for instance, a change of boilers—the whole steam-pressure must have been bottled up without cha of escape.

FEED BACK-PRESSURE VALVES FOR STEAM-BOILERS.—Some of o members do not appear to be fully aware of the importance of fixing a feed back-pr sure valve to each of their boilers, and, therefore, the following instance, lately with, of the inconvenience arising from the want of them may be given. Four bo ers, set side by side, and connected together, were working under their ordinary c cumstances, when one of them vomited its water through the feed-pipe into the adjo ing one, draining itself and overcharging the other. The danger of this, if not imm diately detected, with a fire in active operation, will at once be seen. It is, howev by no means an uncommon occurrence where back-pressure valves are omitted, es cially where any thickening matter exists in the water, which tends to lift it and ca priming, under which circumstances the water has been found to rush backwards forwards alternately between boilers working in connection. The back-pressure va prevents this: the water from the feed-pump operating underneath and raising it, wh the pressure from the boiler operates on the top, and closes it. Necessary as these va are to the safety of boilers when working in a series, they should not be neglected in case of those working singly, not only when fed by a pump, but also when fed di from the waterworks main: in the first case, in order that the pump-valves may be cessible when steam is up; and, in the second, that the reflux of hot water from boiler may be prevented, either on the bursting of the pipe or other cause. These va should be placed immediately upon the shell of the boiler, and not at a distance from as is sometimes the case, since scalding might ensue should any joints break in the tervening length of pipe, while repair could not be effected without letting the pre down. For the same reason, the feed-stop valve should not be interposed, which it frequently is, between the back-pressure valve and the boiler, since a disarrangemen the stop-valve may entail an entire stoppage, which, had the feed back-pressure va been placed immediately upon the shell, could easily be rectified with steam up. In construction of this valve care should be taken to limit its rise, for want of which s ple precaution some of them have proved to be entirely useless, the water passing fr from one boiler to the other, as if the valve were not there. Its most convenient po tion is at the front end plate of the boiler, nearly on a level with the furnace-cro Its beat can be heard at every stroke of the engine, and, if a screw spindle be added as to convert it into a combined feed-stop and back-pressure valve, which is the arrangement, then the feed can be regulated without leaving the furnaces.

BLOW-OUT APPARATUS.—A case of scalding has recently occurred consequence of the failure of the blow-out apparatus of a boiler, which was, howe under the inspection of the association. The manner in which blow-out taps are often strained with long levers, in opening and closing, renders it a matter of surprise that fracture does not more frequently occur, and many have such inefficient arrangements for carrying off the waste water that it beats back with so much violence, on the taps being opened, that their use is quite dangerous. Enginemen are in this way but too frequently scalded severely, and our own inspectors sometimes meet with narrow escapes. Some taps are so inconveniently placed that the nut at the bottom of the plug is quite inaccessible, and thus becomes neglected, in consequence of which several cases have occurred of the plug being shot out by the force of the steam on being opened. Taps fitted with glands are safer, as well as more convenient; they should, however, be made entirely of brass in the shell, as well as in the plug, and be fitted with a suitable waste-pipe. Those made of cast-iron in the shell and brass in the plug are generally found to be inconvenient, and sometimes dangerous, on account of the unequal expansion of the two metals, from which it is frequently impossible to close them, when the boiler becomes robbed of its water, and the fires have to be drawn, to prevent injury to the furnaces. The case in question, however, was somewhat peculiar, and the fracture did not arise from either of the above causes. The blow-out tap was attached to the boiler by a cast-iron elbow pipe, and this pipe broke short off, without warning, while the boiler was at its regular work, and the blow-out tap not being touched. The cause of this appeared to be as follows:—Boilers, as it has been previously stated in these reports, are too frequently considered to be in a state of rest when once set upon their brickwork bed; whereas, from the constant changes of temperature, and the consequent contraction and expansion that take place, not only in the boiler itself, but also in the brickwork, the whole is in a continual state of movement. It appears most probable that this action had in process of time induced a slight settlement of the boiler, and thus that a strain was brought upon the cast-iron elbow pipe, which, being bound by the brickwork, consequently gave way. A torrent of hot water naturally ensued, which, unable to escape by the usual outlet, found its way into an adjoining building, where it partially flooded some of the floors, and two or three persons became scalded in consequence.

Prevention of Incrustation.—It may be stated in brief that the scum-pipes for surface blowing out, which have been recommended from time to time for the prevention of incrustation in boilers have now been adopted by several of the members, and have, for some time since, been in very successful operation. An early opportunity will shortly be taken of making more detailed reference to this subject; but, in the meantime, it may be stated that a drawing of the arrangement adopted lies at the office for the inspection of the members, and that full particulars, both of the details of construction and results of working, will be given on application.

Hints to Members on Laying Down New Boilers.—There is one branch of the service this association affords which the members do not avail themselves so fully as they might—that of consulting the records at the office before laying down new boilers or making alterations. Full particulars are kept, not only of the construction of the boilers under inspection, but also of the results of their working; and a consultation of these would frequently save unnnecessary outlay, prevent failures of one being repeated by others, and place at the command of each member the experience acquired by the inspection of the whole number of boilers under charge of the association.

SALES OF COPPER ORES.

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COPPER ORES SOLD AT THE CORNWALL TICKETINGS, FOR THE QUARTER ENDING SEPTEMBER, 1862.

Mines.	Tons.	Amount.		
Devon Great Consols	6163	£30,219	13	6
Clifford Amalgamated	3594	17,214	8	6
South Caradon	1387	13,027	14	6
East Caradon	1356	9,231	6	0
West Seton	1509	8,815	5	0
West Basset	1354	7,542	4	6
West Caradon	995	7,173	18	6
Phoenix	1285	6,308	15	0
East Carn Brea	903	6,017	2	6
Par Consols	807	5,652	0	6
Fowey Consols	1029	5,463	2	6
Marke Valley	1223	5,191	4	6
North Treskerby	985	4,984	2	6
Wheal Seton	775	4,379	13	6
South Frances	626	4,151	19	6
Great Wheal Busy	1231	3,974	2	0
Wheal Basset	540	3,967	14	6
Holmbush	421	3,764	3	6
South Tolgus	675	3,633	12	0
Wheal Friendship	448	3,218	5	0
Bedford United	638	3,034	7	6
Hingston Down	762	2,817	11	6
Craddock Moor	402	2,809	15	0
East Basset	433	2,770	17	0
East Pool	671	2,755	10	0
North Downs	408	2,579	15	0
North Roskear	364	2,227	19	0
Wheal Margery	417	2,048	12	0
Alfred Consols	573	2,020	4	0
East Russell	340	1,791	17	0
Wheal Emma	412	1,757	17	6
Tolvadden	329	1,757	3	0
Wheal Polmear	340	1,635	15	0
Wheal Agar	229	1,590	10	0
Great Wheal Martha	859	1,541	14	6
Tywarnhaile	421	1,530	15	0
West Damsel	381	1,523	3	6
Wheal Buller	218	1,475	12	0
Crelake	386	1,440	0	6
East Crinnis and South Par	242	1,333	10	0
South Crinnis	275	1,328	13	0
East Rosewarne	173	1,167	16	0
Carn Brea	394	1,148	1	0
Brookwood	184	1,100	14	0
Wheal Grenville	206	1,100	8	0
Great South Tolgus	132	1,084	8	6
Copper Hill	271	1,047	10	0
Tolcarne	176	1,036	13	6
Tincroft	301	1,038	19	0
West Stray Park	172	1,031	8	0
Levant	236	1,023	11	0
Wheal Anna	177	954	16	0
Kelly Bray	270	950	13	0
Devon and Cornwall	245	931	11	6
Wheal Edward	266	929	12	0
Bampfylde	57	897	15	0
Pendeen Consols	199	894	9	0
Lady Bertha	330	805	15	0
Treworlis	177	787	10	6
Condurrow	209	744	15	0
North Wheal Robert	150	728	8	6
Farsden	103	720	14	0
Sortridge Consols	94	706	11	0
St. Day United	218	674	8	6
Rosewarne Consols	75	672	2	6
North Basset	166	645	0	0
South Bedford	222	620	7	0
North Crofty	143	565	19	0
Gurlyn	82	551	11	6
East Alfred Consols	150	532	9	0
Treloweth	82	522	5	0
Wheal Uny	61	520	7	0
Rosewarne United	67	506	19	0
South Crenver	185	493	8	0
Charlotte United	81	482	3	6
Gunnis Lake	100	416	18	0
Hawkmoor	86	401	6	6
Gawton	124	399	6	0
Calstock Consols	85	372	16	0
Prosper United	83	358	13	6
Wheal Harriett	71	358	13	0
Great North Downs	62	350	6	0
North Grambler	55	342	7	6
Prideaux Wood	113	341	16	6
Copper Hill	93	323	12	6
Camborne Vean	73	312	14	6
South Carn Brea	64	301	16	0
Dolcoath	64	296	1	0
Melland	52	287	6	0
Great Brigan	62	283	13	0
Burra Burra	71	282	13	0
North Frances	40	276	0	0
Wheal Arthur	111	269	17	0
Wheal Trevelyan	45	263	5	0
West Wheal Trevelyan	36	255	7	6
Tresavean	104	224	7	0
East Polmear	30	214	10	0
Yarner	77	205	19	6
Stray Park	53	205	7	6
New Treleigh	48	186	0	0
Perran	45	175	5	6
West Alfred Consols	95	172	11	0
West Tolgus	31	167	8	0
Carn Camborne	24	165	0	0
Crane	15	140	18	6
Grambler and St. Aubyn	25	134	7	6
Great Wheal Alfred	54	131	8	0
Wheal Rose	24	124	16	0
Pedn-an-drea	32	124	14	0
Champion's Ore	28	119	14	0
Boscaswell Downs	15	117	15	0
Wheal Jane	18	90	0	0
South Basset	65	89	15	6
Wheal Moyle	22	81	0	6
Falmouth and Sperries	23	80	10	0
Camborne Consols	9	70	4	0
Wheal Unity	15	61	17	6
Wheal Prudence	12	59	2	0
Great Treveddoe	17	57	11	0
South Dolcoath	6	55	13	0
Wheal Emily Henrietta	8	53	0	0
West Providence	10	51	0	0
East Wheal Grenville	18	50	8	0
Cregbrawse	15	46	10	0
Duchy and Peru	87	46	6	0
Trumpet Consols	3	41	6	6
North Busy	7	39	14	6
South Wheal Crofty	13	36	3	0
Wheal Leisure	13	35	2	0
Crowndale	32	£ 34	8	0
Palmountain's Ore	20	33	0	0
Buckingham's Ore	15	32	12	6
Wheal Cubit	3	29	9	6
Cook's Kitchen	13	26	6	6
Stevens's Ore	15	25	10	0
Great Crinnis	8	20	16	0
Higgins's Ore	5	13	12	6
Wheal Gill	3	10	2	6
Wheal Trefusis	3	5	17	0
Total	45011	£233,691	0	0

COMPANIES BY WHOM THE ORES WERE PURCHASED.

Vivian and Sons	5593	£29,886	19	4
Freeman and Co.	2578	13,892	3	2
P. Grenfell and Sons	4209	29,911	11	11
Crown Copper Company	356	1,975	1	3
Sims, Willyams, & Co.	5516	27,557	8	6
Williams, Foster, & Co.	5922	34,721	12	11
Mason and Elkington	5546	28,594	10	9
Bankart and Sons	3147	14,137	13	10
Copper Miners Company	4355	23,506	15	0
Charles Lambert	3338	9,957	18	8
Newton, Keates, and Co.	731	4,242	16	0
Sweetland, Tuttle, and Co.	1822	5,808	9	2
Neath Copper Company	1898	9,497	19	6
Total	45011	£233,691	0	0

THE INTERNATIONAL EXHIBITION—1862.

THE MINERAL RESOURCES OF PORTUGAL.

Although we cannot read the history of the Portuguese a few centuries since without becoming impressed with their untiring enterprise, their energy in modern times has been so small as almost to have caused us to forget their very existence as an industrial people, or if we remember them, to regard them only as a nation completely on the downhill of life. Within the past ten years, however, there have been some signs of rejuvenescence, and, at least with the mineral resources of the country, such progress been made as leads to the opinion that at no distant period the mineral industries will receive that consideration they so justly deserve. Coal, copper, tin, lead, and zinc are comprised amongst the metalliferous products; whilst marbles, building stones, &c., help to augment the general mineral riches of the country. The Portuguese mineral department will be found on the south side of the nave, and although comparatively small in extent, the inspection of it cannot fail to prove instructive. The arrangement of it has been entrusted to Mr. J. de Neves Cabral, who is also one of the jurors in Class I., and it is but justice to him to say that the display is highly creditable.

Beginning with the coal and iron, we have anthracite from Oporto and Aveiro; lignite from Coimbra, Santarem, and Leiria; peat from Lisbon; and iron ores from Leiria and Braga. The anthracitic coal formation of San Pedro de Cova occupies a narrow zone about half a kilometre in breadth, and extending from 8 kilos. south to 50 kilos. north of the River Douro. At several points upon this zone the coal has disappeared entirely, as if by denudation since the formation of the deposit, and which was contemporaneous with the eruption of the diorites, which broke up the beds of coal, and reduced them to the state of anthracite. The chief basin, 2 kilos. in length from N.W. to S.W., and 120 metres broad, is situated at San Pedro da Cova, 2 leagues east of Oporto. This deposit has been worked for 70 years, and at the present time the pits are 60 metres deep. The coal finds a market as a house coal at Oporto, last year's consumption being 80,000 hectolitres. The deposit of anthracite at Pijao, in the district of Aveiro, forms, so to speak, the southern extremity of the carboniferous formation before alluded to: it is here composed of two layers, the one being a soft coal the other hard, shining, and of conchoidal fracture. The carboniferous (lignite) formation of Cabo Mondega, in the Coimbra district, occurs at the junction of the middle oolitic and lias formations. Its outcrop is close to the sea, and shows itself again in the Buarcos mountain, after having followed all the inflexions of the oolitic formation; it disappears altogether at 3 kilos. from the cape under the sands and clays of the lower portion of the cretaceous series. The works undertaken at the close of the last century have given evidence of the continuation of this formation to the seacoast; unfortunately, inundations put an end to the operations. There are five beds, but only one is workable; this is 1 metre thick, and dips 25° S.E. There is another deposit of this lignite in the oolitic formation, about 60 kilos. south of the Cabo Mondego Mine, at Valverde e Cabeço de Veádo, between Leiria and Santarem. There is only one workable seam, averaging 1 metre in thickness. The outcrop of this seam can be followed for 4 kilos. S.E. from Valverde. The coal is often very dry, and is applicable for steam purposes. The mine is now being worked, and is 35 kilos. both from the Tagus and from the railway. The road is bad, but might be cheaply improved. At Chao preto e Alcanadas, in the Leiria district there is a surface of about 100 square kilos., containing a vast variety of fuel, from a lignite very nearly approaching coal in its character, to a fossil wood. There is a deposit of peat of considerable extent at Comporta, in the Lisbon district, but it is not being worked. Veins of magnetic oxide of iron are found at Alequeidao da Serra, and at Serro Ventozo, in the Leiria district, but are not being worked. Micaceous oxide of iron exists at Mendiga, in the same district. Magnetic iron is found at Pitoes Serra do Gerez, in the Braga district, near the frontier of Galicia, but the commercial value of the deposit is not yet tested.

In the province of Alemtejo the granitic rocks are finely developed, and the deposits of copper and lead crop out in such quantity as to render the district one of the richest in Europe. The large masses of copper of San Dominigos, Aljustrel, Grandola, and Portel form part of the same metalliferous zone as the celebrated deposits of Rio Tinto, Tarsis, &c., in the Huelva district of Spain. The length of the corresponding zone in Portugal is not less than 110 kilos., and its width is not yet ascertained. Slags are found in large quantities, and incontestibly prove that metallurgical works were carried on upon a large scale by the ancients; for ages, however, these deposits have been neglected—nay, forgotten; but now a period of industrial activity is commencing, and the deposits are worked in proportion as facilities for intercommunication increase, and the two railways now being constructed will remove to a great extent the difficulties which have existed. Pyrites, black and red oxides, green and blue carbonates, grey ore, &c., are shown in abundance, the most important being in the Beja, Aveiro, and Evora districts. The mine of San Domingos, at Mertola, has a mass of copper pyrites, not holding more than 3½ to 4 per cent. of copper on the average. This mine hus been worked by a French company for three years, and during last year 50,000 tons of ore were exported to England from it. They are now constructing a tramway, 18 kilos in length, to connect the mine with the port of Pomarao, on the left bank of the River Guadiana. The mine at San Joao do Deserto, Aljustrel, is somewhat similar to that at San Domingos, but from the character of the outcrop, several competent engineers have predicted that it will prove not only one of the largest deposits known, but one of the richest also. In the Lisbon district, at the western extremity of the metalliferous zone under consideration, is the mine of Serra da Caveira. Large works seem to have been carried on by the ancients, and it is now intended to recommence explorations. The deposit is 16 kilos. from the navigable river Sado, whence the ores will be sent to Setubal, and the construction of a tramway to connect the mine with the river would cost very little. The deposit at Portel is very similar to that at San Domingos, Aljustrel, and Grandola, and traces of ancient works are very common. The mines are 16 kilos. to the Beija Railway. They are beginning to work the Herdade da Moostardeira Mine, from which some good specimens of black and red oxides are exhibited. The lode from which the samples are shown is 2 metres thick. The mine was worked by the Romans, who have left considerable marks of their work. The deposit is 3 kilos. from Estremoz, through which the railway from Evora to Villa Viçosa will pass. Mr. José Rodriguez Tocha also exhibits specimens of carbonate and red oxides of copper from Conceiçao, in the Evora district. The mine will shortly be put to work; the formation is similar to that at Herdade da Moostardeira. The same gentleman exhibits copper pyrites, grey copper, red oxide, and carbonates from Xeres e Barcas, on the Guadiana. The outcrop is very large, and the thickness of the vein, which has been explored to some depth, is fully 1 metre. This mine is 40 kilos. from Evora, whence the Southern Railway, at present constructing, will run.

But indeed the copper deposits of Portugal are so numerous, and so well worthy of attention, that we might continue to describe almost every mine from which specimens have been sent, and should have few upon which to pronounce an unfavourable opinion. At Herdade de Ruy Gomez, in the Beja district, there are two veins of copper pyrites running north-east and south-west, and associated with calc-spar, talcose schist, and a little quartz. There are some shallow workings of the ancients here. The river would furnish ample water for dressing purposes, and during some eight months in the year a wheel of 10 or 20-horse power could be driven. The distance of the mine from Beja, or from the Southern Railway, is about 50 kilos. Around the little village of San Manços, 16 kilos. south of Evora, will be found in a district very little disordered a considerable number of outcrops of copper veins, between east and west and north north-east, south-south-west, the greater part of which were superficially worked by the Romans. Of all these deposits there is but one upon which operations have been commenced, that of the Herdade do Castello, which is formed of a large vein, the outcrop of which is 4 metres thick, and follows the crest of a hill for 1200 metres. This outcrop is composed of quartzites, considerably impregnated with oxide of iron and carbonate and red oxide of copper, sulphate of barytes and calc-spar being frequently met with. This mine is 15 kilos. from the railway, the road to which is very good. There is not an abundance of water here, and other power would be required for driving the necessary stamping and dressing machinery, as well as for unwatering the mine, and the same remark applies to most of the mines in the province of Alemtejo, which is very flat, especially in the Evora and Beja districts. There are also copper ores from Bugalho, in Evora; from Alte, Boliqueme, and Malhada, in Faro; and from Algôso, in Braganca; but those in which the English visitor will, perhaps, take the greatest interest are the specimens from Palhal, worked under the management of Messrs. Taylor by the Lusitanian Mining Company.

The Palhal Mines are the richest copper mines at present known in Portugal. They contain four distinct copper lodes, containing galena as an accidental product; they have a direction almost due east and west. The enveloping rocks are metamorphic schists passing into very quartzose gneiss, with black mica, hard quartzose schists, and talcose schists, having a general direction north and south magnetic. The operations at the Palhal Mines are carried on with great energy; about 360 persons are employed, of whom 140 are miners. The depth of the mine is 150 metres. From 1854, when active operations were commenced, to the end of 1860, the company raised 5065 tons of ore of all quality. At present the chief ores are copper pyrites and grey argentiferous copper, but recently sulpho-antimonide of silver has also been met with. The position of the mine is excellent; the River Caima, which traverses the outcrops, furnishes considerable motive power. The country is well wooded, and the distance of the mine from the shipping port and from the railway is but 12 kilos. The specimens of copper pyrites, black oxide of copper, &c., from Telhadella are excellent. The mine has been worked about a year, has three lodes similar to those at Palhal, and the facilities as to water power, shipment, &c., are fully equal; so that little doubt is entertained that when further explored it will prove equally profitable. The grey copper from St. Estevao, in Faro, is well worthy of attention, the ore found in the district being very pure, and frequently containing native copper. The copper pyrites from Crugeira, in the Beja district, are also good, and it seems very probable that the exploration of the old Roman mine of Vinhas Velhas would be attended with profitable results. At Vinhas Velhas, Montinho, Valle da Arrabaça, and Onteiro dos Algares the facilities for working are very great, yet little has been done for developing the resources of the mine.

Tin ores are exhibited from the Oporto, Vizeu, and Bragança districts, and there is also a box of washed tin, which is well worthy of attention. First, there is the oxide of tin from Rodas de Marao; the lode from which this sample is obtained, and which is one of several, is half a metre wide, and situated about two leagues north-east of Amarante, in the Serra do Marao. These lodes occur in crystalline schists, which take the direction north 30° west, the matrix being quartz, accompanied by micaceous and talcose rocks; the mine is being worked, but with very little activity. The Perseverança Company also exhibit oxide of tin from the Oporto district; the mine from which it comes is at Rebordoza, about 23 kilos. to the north-east of Oporto; it is also worked upon a very limited scale. The tin deposit at Paranhos, in the Vizeu district, is represented by the sample exhibited by Mr. Roldan. The size of the lodes vary from 5 millein to 1 metre, and the facilities for working the mine are very great. The principal portion of the deposit is in a hill, on two sides of which there are two small rivers, which would furnish ample water for winding and pumping power, as well as for dressing purposes. Besides this, the country is so well wooded that the smelting could be carried on upon the spot. The distance of the deposit from the northern railway is nearly 60 kilos. The tin mines of Paredes, Paradella, and San Martinho d'Angueira, in the Bragança district, are each remarkable for the richness of the deposits, and for the great facilities for working. These, as well as others which have been discovered, but are not so well known, are situated upon a zone of crystalline schists, 6 kilos. broad and of considerable extent, being, in fact, part of the same zone which contains the well-known deposits of Carvajosa, Villa Pera, and Serenal, in Spain. Notwithstanding the richness of these deposits they have not been regularly worked, all that has been done being to pick the surface at the outcrops, which are generally found to yield a fair proportion of metal. Most of these deposits could be worked by day levels; there is ample water for dressing purposes; timber, although not abundant in the immediate vicinity, can be had at a reasonable price, and brushwood being very plentiful, there would be no obstacles to carrying on extensive operations, both mining and smelting.

There is an excellent display of lead ores from the districts of Castello Branca, Santarem, Beja, and Aveiro. The metalliferous region, of which the little village of San Miguel d'Ache occupies the centre, extends at least 30 kilos. Upon the granitic formation of which the district consists may be seen the outcrop of veins, most of which are well defined, of argentiferous galena (with 1-2000th of silver), with which is sometimes associated blende and sulphide of copper; the veins generally run east north-east and north south-west. Some exploratory operations have been carried on upon some of these veins, and have given very good results. Exploratory works have also been done at Castello das Caldeiras, but they have not been sufficient to determine the value of the deposits; however, the favourable character of the outcrops of several of the veins which may be traced for a great distance, the fact that the mine is but 3 kilos. from Sardoal, on the Tagus, or from the Eastern Railway, and the great advantage of having in the locality ample water, both for the dressing of the ores and the production of motive-power, should offer great inducements for working the property upon a suitable scale. From Morena a specimen of galena and sulphate of barytes is shown; at a few metres depth the galena becomes very pure, granular, and lamellar. Several samples have been analysed, and found to contain on an average 1-1000th of silver. This deposit is also well situated, the shipping port on the Guadiana being but 5 kilos. distant. The collection from Aveiro is a rather large one. The Braçal and Malhada Mines, of course, occupy the first position, both the mines being included in one concession under the former name. The Malhada lodes are certainly the richest; there are three being worked of a mean width of 1 metre, and not unfrequently enlarging to 2 or 3 metres, quite full of pure ore; the mean percentage, however, is about 25 per cent. This mine has been in full work since 1840, and at the present time the depth is 90 metres, and about 380 persons are employed. Dressing operations are carried on upon the most approved systems practised in the Hartz; all the metallurgic operations are effected in the immediate vicinity of the mine, and new lead smelting-furnaces are now being constructed, as well as the necessary plant for extracting the silver by the crystallisation process. The Coval da Mo Mine forms the western continuation of Bracal and Malhada, and is of a character to fully justify the most favourable indications. At Moinho da Pena an argentiferous galena deposit is also being worked, and, although as yet its character is only superficially known, there appears to be very great inducement to carry on the operations with energy. This mine is most favourably situated. The Caima traverses the outcrops, and furnishes ample power for all purposes; there is a pine forest in the vicinity, and the shipping port is but from 2 to 5 kilos. distant. The lead ore from this mine is usually very argentiferous, the lead containing 513 grammes of silver to the 1000 kilos. From Telhadella silver-lead, galena, with copper pyrites, and fire-bricks are shown, and from Bracal some good smelting products. There is argentiferous galena from the Lusitanian Company's mine of Palhal, where it is found associated with the copper ore already referred to, and galena with iron pyrites and quartz from their other mine, the Carvalhal; there are several veins within the concession of Carvalhal, but only one seems to be worth working. This is a good vein, from 1 to 3 metres big, but the galena being often mixed with blende, iron pyrites, and arsenical pyrites, it is difficult mechanically to separate the ore. The mine is situated on the Caima, and the facilities for working it are the same as with the other mines on the same river. There seems to be a good mine at Varzea de Trevoes, from which argentiferous galena and lead are exhibited; the veins run east and west, and traverse the bed of a brook from which ample water for dressing purposes and for furnishing motive-power to the extent of 25 or 30-horse power could be obtained during nine months of the year. This mine is 12 kilos. from the shipping port on the Douro, and the road is very bad.

Antimony ores are exhibited from Cortes Pereira and from Valongo; at the former place, close to the Guadiana, there is a rich vein of sulphide of antimony, the outcrop of which can be traced for 1500 metres; it has been worked for two years, the produce being shipped on the right bank of the Guadiana, 2 kilometres distant. There also two antimony mines, from which specimens are shown, 2 leagues north-east of Oporto; they are called the Ribeiro de Igreja and the Valle d'Ache; the former is interesting from its occupying just the northern extremity of the Serra da Santa Justa, where great Roman works may be seen. It is difficult to ascertain the object of these works, the lode being entirely empty to a great depth, but it is supposed that it was worked for the auriferous quartz. Both at Ribeira da Igreja and at Valle d'Ache the works are upon a very small scale. There are some half-dozen samples of blende, the principal of which are from San Miguel d'Ache, where it is associated in large quantities with the galena, and from Carvalhal, as has been already remarked.

Turning to the non-metalliferous minerals, we have the peroxide of manganese from Almagreira and from Herdade dos Pretos, both in the Evora district. The deposit at Almagreira is 30 metres thick, and its length and depth is not known, the works only having reached 25 metres; enough, however, has been seen to show that both are considerable. Manganese deposits abound in the province of Alemtejo; there are at present 28 deposits conceded, or in the course of concession. The deposit at Herdades dos Pretos is not yet being worked. Asphaltic lime, bituminous sand, and mineral tar are exhibited from Azeche, in the Leiria district. These deposits are situated on the sea coast, and 30 kilometres distant from the seaport of San Martinho; they occur under the sands of lower cretaceous formation, which cover a large extent of the province of Estremadura; they are composed of gypsum clays, bituminous schists and lime, and of sand agglutinated by considerable quantities of asphalte. The marbles exhibited are of great beauty, and as the price at which the several kinds can be supplied f.o.b. at Lisbon, and which is very low, has been affixed to them, the collection is inspected with greater pleasure and advantage than those from other countries, where one is left to conclude that the samples sent are isolated specimens rather than regular industrial products. White, red, dove, green, rose, black, and grey marbles, veined in the most beautiful manner with various colours, as well as breccias of the most attractive kind, are shown; whilst the prices at which they can be supplied cannot fail to give them a position in the market. There are breccia table tops, admirably finished, which are offered at from 3*l.* to 4*l.*; and a large table and foot, composed of 96 specimens of the choicest Lusitanian marbles, for 44*l.* 9s. Millstones, granite, conglomerate, and zechstein, as well as slates, barytes, limes, pouzzolane, pumice, ochre of various colours, salt, kaolin, and potters' clay, are likewise exhibited in abundance, each specimen meriting a detailed description, from the large field for the more extensive production and consumption of the materials which might be developed.

In concluding our notice of the mineral resources of Portugal, as represented in the International Exhibition, we must mention one small case, in which a large number of Englishmen take some interest; it occupies the centre of the Portuguese mineral court, and contains a number of beautiful specimens of malachite from the mines of the Western African Malachite Company, at Bembe, in the Portuguese colony in Africa. The quality of the malachite appears to be excellent, but the mines being situated 95 miles from the coast, and separated from it by robbers and hostile bands of natives, the profits anticipated have not been realised: another mine, however (said to produce malachite equal to that at Bembe), has now been discovered, which, being only four miles from the coast, is far more favourably situated for working.

IRON AND STEEL DIRECT FROM THE ORE.—In the conversion of cast, pig, or other iron into steel, Messrs. Gardner, of New York, propose to subject it when in a molten state to the combined action of crude potash or other alkali, carbonate of lime, oxide of manganese, and charcoal. The invention also consists in the purifying or refining of the iron, preparatory to such process of conversion either during its reduction from the ore in a smelting furnace, or during a subsequent melting by the use of ores of zinc, or the pure metal (zinc) itself, and of jets of steam or water. By means of these improvements steel may be manufactured directly, or by a continuous process, either from the ore or from pig-iron. For obtaining refined iron for conversion into steel they generally use a smelting furnace of ordinary construction, and after each charge of fuel has been put in and become well lighted, place directly upon it a charge of zinc ore, equal in weight to form 15 to 20 per cent. of the charge of iron ore, which they throw in above the zinc. An ore of zinc with a hard gangue is generally selected. The ore known as Franklinite, obtained in New Jersey, in the United States of America, is found to serve a good purpose, but other ores of zinc combined with iron will answer, a less or greater quantity being required, according as it contains more or less zinc or the pure metal (zinc) may be used. When it is desirable to increase the heat a small jet of steam or water is admitted to the furnace through the tuyeres along with the blast, and by that means the iron is made to part with its carbon, and oxygen is supplied for the support of combustion, while the hydrogen of the water, combining with free carbon, produces carburetted hydrogen, which increases the heat. The zinc being of a volatile nature, and so susceptible to combination with sulphur and other volatile matters, which are carried out of the furnace by the zinc in the form of a flocculent vapour. Care should be taken in the use of steam or water not to increase the heat too much, but only to such a degree as to effect a complete scorification of the iron. The refining or purifying of iron by the use of zinc and steam or water may be performed in a substantially similar manner in a subsequent melting of pig or cast-iron, which has been obtained by the usual process of smelting and reducing. In order to convert the iron into steel, they generally use a reverberatory furnace of form substantially similar to a puddling furnace, with the flue and stack at the opposite end to the fire-place, and a basin of sufficient size to hold the charge; but the working door is arranged directly under the flue, so that the current of cold air, which is unavoidably admitted in working, may be met by the current of hot air and gases or flame from the furnace, and carried with it up the stack, without being permitted to effect the metal in the body of the furnace. When the above-described process of smelting and purifying the iron is to be used in connection with the process of converting the iron into steel, the reverberatory furnace is arranged in such relation to the smelting or purifying furnace before mentioned that the molten iron can be run from the latter directly into the basin of the reverberatory furnace, through a suitable opening in the top or side of the latter furnace; but when the iron is introduced into the reverberatory furnace in the solid state, as may be the case, the latter furnace may be arranged in any convenient situation, and should be provided with a charging opening in one side, such opening requiring to be bricked up and luted, to exclude cold air during the converting process. The process of conversion is thus performed. The reverberatory is first heated, and if the metal is to be run in in a molten state, as above described, the converting substances (as crude potash or other alkali, carbonate of lime, oxide of manganese, and charcoal) are introduced to and spread over the bottom of the basin of the furnace before the fluid iron is run in; but if the iron is introduced in a solid state the converting substance may be introduced either before the introduction of the iron, or when it has become hot enough to give off its gases. The quantities of the converting substances to be employed for the conversion of iron are generally in the proportion of about 25 lbs. of each such substances to 1 ton of iron: they prefer to use oyster shells to any other form of carbonate of lime, on account of their high degree of purity, and they prefer the black oxide to any other oxide of manganese. The charcoal should be either pulverised or broken into small pieces. If the iron has been introduced into the reverberatory furnace in a fluid state it may be allowed to remain therein in a molten state, which is maintained by keeping the furnace at a proper heat until it is scorified, taking care to stir it from time to time with a ravel, or other proper implement. Some of the contents may then be taken out with a trier, in order to ascertain its temper and quality, which can be at once known by the practised steel manufacturer; and if the degree of carbonisation be not high enough, a small quantity of carbonate of lime, mixed with an equal quantity of pulverised charcoal, wet with water, may be added, or if the metal be too highly carbonised a green wood pole may be inserted through the working door, and its end forced down through the molten mass to the bottom of the furnace, thereby supplying hydrogen to displace the excess of carbon, and producing an agitation of the whole body of the metal, and when a proper degree of carbonisation has been obtained the metal can be tapped from the furnace, and moulded ready for the hammer or rolls, as may be desired. If the iron has been introduced into the furnace in a solid state it must be first allowed to melt, and when melted it should be stirred for some time until scorified, and then tested, and according to its condition may be proceeded with as described. When the iron is introduced in the solid state it should be broken into small pieces.

IMPROVEMENTS IN PUMPS.—An invention, which has for its object improvements in pumps, has been provisionally specified by Mr. F. W. Gerish, of East-road, City-road. In order to give a reciprocating right line motion to the pump-rod, a fixed toothed wheel is employed, and the shaft which gives motion to the pump-rod passes through and rotates within the centre of the fixed cog-wheel. On this shaft is a crank, on the crank-pin of which is mounted a pinion, the teeth of which gear into the teeth of the fixed cog-wheel. To the pinion the end of the pump-rod is attached at a distance from its centre corresponding with the radius of the crank; hence by the rotation of the shaft the crank will carry the pinion round with it, and as the teeth of the pinion at all times gear with the teeth of the fixed wheel, the pinion is caused to rotate on the crank-pin, so that, supposing the pump-barrel to be vertical, the pump-rod will at all times be vertical, and will, when at its highest point, cross the centre of the fixed wheel, which by preference is formed with internal teeth. The barrel of a pump may, when desired, be in a horizontal or other position.

SUBSTITUTE FOR GUNPOWDER.—Mr. E. Harrison, Oldham, proposes, as a substitute for ordinary gunpowder, a composition formed of nitrate and chlorate of soda or potash, starch, ferrocyanide of potash, and charcoal. He gives several lists of proportions which may be used thus—Firstly, chlorate of potash, 12 parts; nitrate of potash, 6 parts; starch, 2 parts: ferrocyanide of potash, 4 parts; and charcoal, 1 part: or, secondly, chlorate of soda, 12 parts; nitrate of soda, 6 parts, with starch, ferrocyanide of potash, and charcoal, as before: or, thirdly, chlorate of potash, 12 parts; nitrate of soda, 6 parts, with starch, ferrocyanide of potash, and charcoal, as before: or, fourthly, chlorate of soda, 12 parts; nitrate of potash, 6 parts, with the other ingredients, as described in the other examples. We should think these mixtures would be very liable to absorb moisture, and become worthless, unless very carefully cared for.

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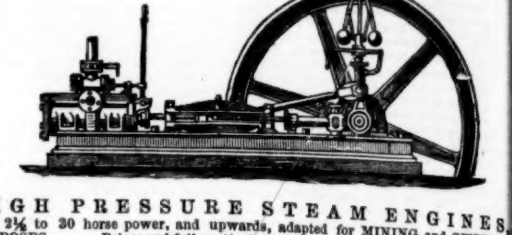

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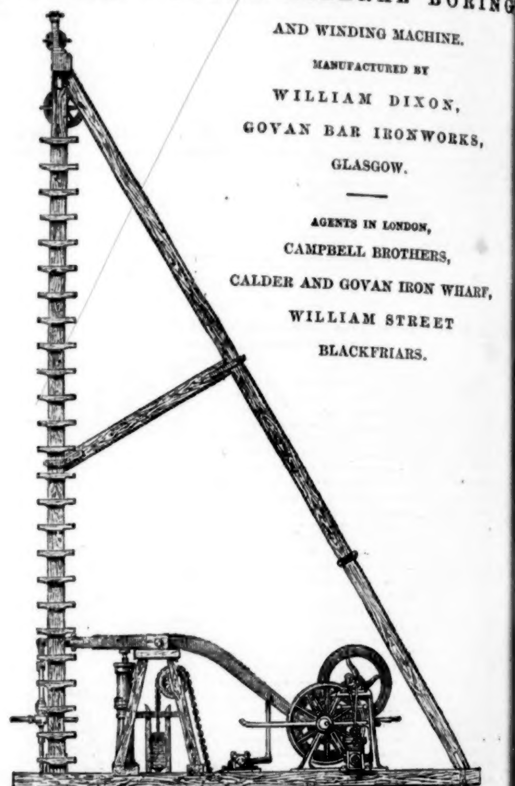

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